regions, the period is reduced to ten, if not to five or fewer days. All this, we are asked to believe, is the work of the latest of our nebular annexations, which, forming an equatorial girdle round the sun, partially, and in a degree varying inversely with latitude, communicated its own more rapid movement to the superficial layers of the globe it encompassed.

The process is not even yet concluded. What Dr. Braun holds to be indisputable proof of atmospheric acceleration is derived from Prof. Young's spectroscopic measurement, in 1876, of the sun's rotational velocity. But this is to lay upon the observations in question a burden of inference heavier than they will bear. The rate of equatorial movement, as computed from the observed translation of spots, is 1·25 miles a second; it came out 1·42 miles from the Dartmouth College measures. Considering, however, the extreme minuteness of the entire displacements due to this speed, amounting, for the D lines, to but $\frac{1}{77}$ of the interval between them, the discrepancy is hardly surprising; and it is well known that, in this particular class of determinations, errors lie almost always on the side of excess. Prof. Young himself, it is true, was "inclined to think" that his result betrayed an actual sweeping forward of the absorbing layers over the underlying surface; but even were the fact established, we should expect to find for it a cause less remote than the inrush of a nebula uncounted millions of years ago. Undoubtedly, however (so far we are in agreement with Dr. Braun), that cause would be found to be closely connected with the anomalies of the sun's rotation.

As regards the distribution and periodicity of spots, we are in the present work offered simple and avowed conjectures at which we need only glance in passing. The nebulous swathing not yet completely incorporated with the sun's mass impedes, and has during past ages still more effectually impeded, equatorial radiation. Hence, cooling has, in polar tracts, penetrated further into the interior, with the result of generating an internal spheroidal surface at which temperature-gradients attain a maximum, and from the middle latitudes of which special facilities are afforded for eruptive outbreaks.

But this device is assuredly not a practicable one. The highly artificial arrangement it establishes could not endure one hour. Convection-currents would speedily and without ceremony abolish it. Indeed, augmented radiation from near the poles (which is equivalent to more rapid cooling), besides being contradicted by observation, might be expected to produce just the opposite effect of intensifying the disturbances attendant on cooling. Spots and flames should then, on the hypothesis advanced, be transferred from their "royal" zones to the polar calottes.

Heat-pulsations in a period of $11\frac{1}{3}$ years, occasioned, perhaps, by a slow mechanical oscillation of the sun's volume, the progressive contraction of which may be conducted rhythmically, or by regular alternations of shrinking and swelling, are invoked (certainly under every reserve) to solve the puzzle of the sunspot cycle. The difficulties attending what might be called the "disturbed thermal equilibrium" theory of solar phenomena could not be more forcibly illustrated than by the straits to which it reduces its advocates.

The study of coronal appearances compels our author to take refuge in the unassailable stronghold of electricity. We are far from asserting that he is not fully justified in this measure: the circumstances indeed seem to prescribe it; yet it is always felt to be a desperate one, for the reason that it lands us, almost completely, in the region of the unknown. It is right to add that Dr. Braun is at all times evidently loth to separate from the company of ascertained facts and laws. He advances without them only where their escort cannot be made available.

A. M. CLERKE.

MUSIC IN NATURE.

IN the February number of *Longman's Magazine*, there is a remarkable article "On Melody in Speech," by Mr. F. Weber, Resident Organist of the German Chapel Royal, St. James's Palace. The object of the writer is more comprehensive than his title expresses, for he says in his opening paragraph, "There is an infinite variety of interesting and pleasing sounds in Nature's music around us that may be noted by an attentive ear." This may be readily granted; but Mr. Weber goes on, "These sounds are mostly melodious and harmonious, or *in some harmonious connexion, and form exact intervals and chords.*"

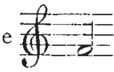
This last sentence is the point of the article. Mr. Weber is not expressing himself figuratively: he writes as a musician, and he distinctly asserts that many of the sounds spontaneously produced in Nature are truly MUSIC in the musician's, and not the poet's, sense of the term. To illustrate this assertion he has taken the trouble to identify and write down, in actual musical notes, the musical passages which he considers he has recognized in a great variety of these natural sounds, and so has challenged the public judgment on the accuracy of his theory.

Now, Mr. Weber is a gentleman of eminence in his profession, and what he says deserves attention. It is easy to say that he has given his imagination too much play in his supposed identifications; but it seems to me the subject ought to be approached from a more comprehensive point of view. The question is, Do such sounds or series of sounds constitute music? or do they not? And if not, why not? If Mr. Weber is wrong, it is probably because he has formed too hasty a view of what music really is; and this is a point that requires serious discussion.

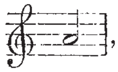
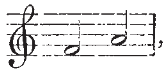
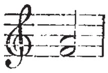
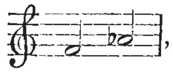
Mr. Weber is not the first who has had this idea. Half a century ago, Gardiner, of Leicester, also a clever musician, published a book called, I think, the "Music of Nature," in which he wrote down musical passages professedly representing a vast number of natural sequences of sounds. There are many other persons, who, while they would not go to the same length as Mr. Weber or Gardiner, still believe that music may be found in the sounds of Nature, and it is worth while to see what grounds there are for such a belief.

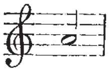
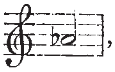
Music, in its modern form, is a very complicated structure, combining many elements, such as melody, harmony, counterpoint, tonality, measured time, rhythm, form, expression, tone-colour, and so on. But no one will suppose that the combination of all these is necessary to make what may be strictly called music. We must begin at the other end, and ask what music is if reduced to its simplest possible form? What are the fewest and least conditions absolutely necessary to constitute music, *i.e.* to give the name of music to a combination of sounds?

In the first place, we must have the proper material, namely *musical sounds*, and we must be particular that the sounds are really of a musical character. I am not going into acoustics. I need only say that the most essential quality necessary to give a sound this character is that it must have a *fixed and definite pitch*. A sound that is wavering and indefinite, like the sighing of the wind, or the *portamento* of a voice or violin, though it may be loosely said to be musical, is not strictly a "musical sound." It cannot be defined by the number of its vibrations, it cannot be expressed in any musical notation, and it cannot be used to form musical structure. For this purpose a sound, though it may be short, must be perfectly definite.

Now, suppose we have a sound of this kind, producing say this note . Does the sounding of this note of itself constitute music? We must say No; for the reason that music is an artistic *structure*, which cannot consist of one sound only. We must have other sounds to build up with it. We should hesitate, practically as well as theoretically, to give the name of music to a monotone.

Supposing, then, we add another sound, differing in pitch. Will these two sounds, heard either together or in succession, constitute music? The answer depends on the relation which the pitches of the two sounds bear to each other. For reasons which can be explained, but which it is unnecessary to go into here, it has been settled, by the universal concurrence of all nations who have made music an artistic structure, that the sounds to be used therein may not be chosen at random, but shall only be such as bear certain defined relations of pitch to each other. These relations have varied at different times and among different peoples; in our case they refer to our acknowledged musical *scales*.[1] Hence the answer to our question will be that if the two sounds are related to each other in a way accordant with our scales (but not otherwise) they may be used to form a part of our artistic musical structure, and do constitute elementary music.

Thus, suppose the second sound to vibrate quicker than the first one in the proportion of 5 to 4, or so near to this ratio that it may be mistaken by the ear for it. This will produce the note , having a relation to the former acknowledged in our scales. Then the two notes sounded successively , or together , will constitute music; the former being an element of melody, the latter of harmony. Similarly in the proportion of 6 to 5, , the same thing may be said.

But if we suppose the vibrations of the second sound to have the ratio to those of the first one of 49 to 40, giving a note about half way between  and , we should decline to acknowledge the succession or combination as music according to our understanding of the term, though it might be so in the systems of the Greeks or of other nations.

We arrive, therefore, at the conclusion that the essential feature of music, its minimum component, must be a combination of sounds of different pitches, these pitches being moreover strictly fixed and defined, and their relations to each other corresponding to certain series agreed on and adopted as standard musical scales. Such combination will of itself constitute music; we may add all sorts of other features; but without the above essential foundation we cannot have music, in an artistic point of view.

This definition will enable us now to inquire whether or to what extent "music" in this sense is actually to be met with in Nature, or in the sources mentioned by Mr. Weber.

To begin with, the natural production of the first requisite, *i.e.* notes of fixed and definite pitch, is not frequent. Most sounds naturally produced are uncertain and wavering; precision in pitch of a sound always conveys an impression of artificiality, of its being, in fact, made purposely musical. No doubt natural sounds of definite pitch, even long sustained, do occur. The nightingale is remarkable for a beautiful long steady holding note; a quail gives three notes successively, at the same definite pitch; other birds, and occasionally some animals, give short notes clearly defined; and such notes may even be produced by inanimate causes of steady action, as a waterfall, or any substance naturally set in elastic vibration. All these, however, are exceptional.

But if there is this difficulty in getting one musically-defined note, it will be still harder to find in any natural source the occurrence of two or more such notes that are musically related to each other. The case that will probably first occur to one's mind is the song of our old friend the cuckoo, who has been immortalized by Beethoven as a musical performer. There was some time ago a controversy as to the true notes of the cuckoo, in which some eminent musicians took part; but I fancy the case is the same as the well-known fable of the chameleon: each of the witnesses was right, but the true solution of the question escaped them all. The facts would appear to be as follow.

The cuckoo gives out successively two very distinct strictly musical sounds, and his vocal organs are so proportioned that the interval between them may vary from about two semitones to five. This interval changes with the bird's age. Early in the season it is at its smallest. On May 5 last I heard on the Monte Sacro, at Orta, in Italy, a bird with a splendid voice give notes about a tone apart: late in the season I have heard them fully at a fourth interval. Of course, therefore, as the change goes gradually on they will pass through a minor third and then through a major third (which is Beethoven's interval); but the *exactitude* is all a matter of chance. I have noticed sometimes that the interval lay between a minor and a major third, so that I could not decide to which it inclined. Hence the idea that the cuckoo gives, by predetermined arrangement, any interval recognized in musical scales, is quite a fallacy.

Mr. Weber asserts that "all the animals on land, quadrupeds and bipeds, have their characteristic voices and calls in distinct intervals. The cow gives a perfect fifth and octave or tenth; the dog barks in a fifth or fourth; the donkey brays in a perfect octave; the horse neighs in a descent on the chromatic scale; the cat in a meek mood cries in a fifth, or, when excited, in a major third; proud chanticleer crows in the diminished triad and [in the diminished] seventh chord." All these Mr. Weber writes down; but I fear that more careful observation would never substantiate the idea that the intervals do really correspond with those of our very artificial scales, otherwise than occasionally by pure accident.

But he makes also inanimate objects conform to our musical system.[1] The wind, he says, sings certain melodies, precisely according to our scales and to our notation, in which he writes them down. This is even more incredible.

Then we come to the main topic of Mr. Weber's essay, "Melody in Speech." He gives a large number of examples, written out fully in musical notation, professing to represent natural language in different varieties: casual expressions, salutations, questions and answers, conversations, and winding up with a speech of an Oxford Professor and a sermon of an English Bishop. These representations are very curious; but it is of course open to any musician to observe for himself the language he hears every hour of the day, and to judge how far it corresponds with this alleged musical character. There is, however, a more conclusive form of test, by what we may call the reverse method. Take the following example given by Mr. Weber :—

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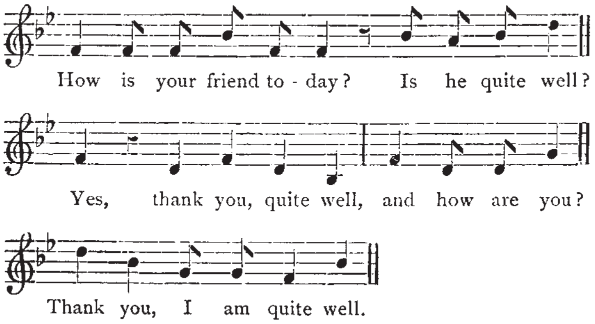
[1] Further explanations on this point will be found in my "Philosophy o Music," Second Edition (London: Trübner; and Novello and Co., 1887). f

[1] Of course we must exclude from consideration the natural harmonics of vibrating bodies, with which our system is purposely connected. Some really musical effects of the wind may be exceptionally produced in this way.


How is your friend to - day? Is he quite well?
Yes, thank you, quite well, and how are you?
Thank you, I am quite well.

Now, let anyone execute this as written ; and then ask the bystanders whether it represents the manner in which the sentences would be expressed in talking. I think they would say, "That is not *talking ;* it is *singing ;*—it is opera recitative." And so on for all the examples. Mr. Weber seems to ignore the essential difference between the two ; *i.e.* the absence, in speaking, of the requisites to constitute elementary music. In the first place, in natural speaking there are no musical sounds, properly so called, inasmuch as it is scarcely possible for a hearer to catch notes of fixed and definite pitch ; the voice tends constantly to wander about in a vague and indefinite way ; the vocal cords, under the natural prompting, have no tendency to remain at a permanent degree of tension ; to keep them so there must be an intentional artificial effort ; and hence the occurrence, in speaking, of a monotone long sustained is unusual, and has a distinct musical character.

But if we could occasionally trace, in speaking, sounds of definite pitch, we should find the other requisite—namely, definite relations between them—wholly wanting. The idea that a person, when he speaks naturally (be he musician or no musician), has our scales in his mind, and makes his voice conform to them, is altogether untenable. The moment this is done it ceases to be natural speaking, and becomes designed musical performance.

Here, therefore, we find a most positive and unmistakable distinction between natural speech and music. The person using his voice must, for the latter purpose, do two things which require predetermination and effort ; and which are therefore essentially artificial and not naturally prompted : he must execute tones of well-defined pitch, and he must give them certain definite pitch relations with each other.

Mr. Weber has, in this matter, unintentionally approached very nearly a matter much debated among philosophers, namely, the Origin of Music. Mr. Herbert Spencer, some years ago, propounded a theory that music had taken its rise from the inflections of the voice in ordinary language. This has been strongly controverted ; but Mr. Weber goes further, and asserts that ordinary language is actually *music ready made !*

He has given, as a part of his illustrations, some interesting examples of street cries. These have no doubt a really musical character ; but it is odd that he did not see the distinction between them and ordinary talking—namely, that such cries and calls are *purposely sung*, and not spoken in the natural way. Of course, conforming to this condition, they can be correctly written down, and reasoned upon as specimens of true musical melody.

There is a useful moral to be drawn from all this ; namely, a regret at the discouragement which is given to the study of the theory of music in a scientific point of view. Grove's Dictionary declares this to be useless to practical musicians, and so it is as long as they confine themselves to practice ; but when they meddle with theory the want of it must instantly make itself known. It is no disrespect to Mr. Weber to say that his article shows the loose way in which such matters are too often regarded. No one who has taken the very first steps in the philosophical study of the structure of music could entertain the idea that the sounds naturally emitted by birds, cows, or dogs, formed by the howling of the wind, or used in conversation, were entitled to be called either "music" or "melody." WILLIAM POLE.

THE BRITISH MUSEUM (NATURAL HISTORY BRANCH).

AMONGST the many new and interesting features connected with the British Museum (Natural History), Cromwell Road, has been the opening of a new gallery to the public, containing the Historical and Type Collections in the Department of Geology and Palæontology, under the care of Dr. Henry Woodward, F.R.S., who has favoured us with the following account of the same.

Taking the exhibition cases in *chronological order*, the earliest is the "Sloane Collection." This is the most ancient portion of the Geological Collection, having formed a part of the Museum of Sir Hans Sloane, Bart., F.R.S., acquired by purchase for the nation in 1753.

The geological specimens are stated to have consisted "in what by way of distinction are called *extraneous fossils*, comprehending petrified bodies, as trees or parts of them ; herbaceous plants ; animal substances," &c., and reported to be "the most extensive and most curious that ever was seen of its kind." Until 1857 the fossils and minerals formed one collection, so that a large part of the Sloane Collection consisted probably of mineral bodies and *not organic*, but in any case only about 100 specimens of invertebrate fossils can now be identified with certainty as forming part of the original Sloane Museum. Each specimen in the Sloane Collection had originally a number attached to it, corresponding to a carefully prepared Manuscript Catalogue, still preserved, which contains many curious entries concerning the various objects in the Museum. In the course of more than 130 years, many of these numbers have been detached from the objects or obliterated in cleaning. But as all fossils at this early date were looked upon *merely as curiosities*, but little attention was paid to the formation or locality whence they were derived. Historically, the collection has immense interest to us, marking the rapid strides which the science of geology has made of late years, especially as regards its more careful and systematic methods of study.

The next collection in chronological order is the "Brander Collection," and is the earliest one in which types of named and described species have been preserved.

This collection was formed by Gustavus Brander, F.R.S., in the earlier half of the last century, and an account of the same, with eight quarto plates, was published in 1766, entitled, "Fossilia Hantoniensia Collecta, et in Musæo Britannico deposita." The descriptions of the species given in the work were written by Dr. Solander, one of the Officers of the British Museum. They were "collected in the County of Hampshire, out of the cliffs by the sea-coast between Christchurch and Lymington, but more especially about the cliffs by the village of Hordwell, nearly midway betwixt the two former places" (*op. cit.* p. 111).

Only a small number out of the original 120 figured specimens are now capable of being identified, the rest